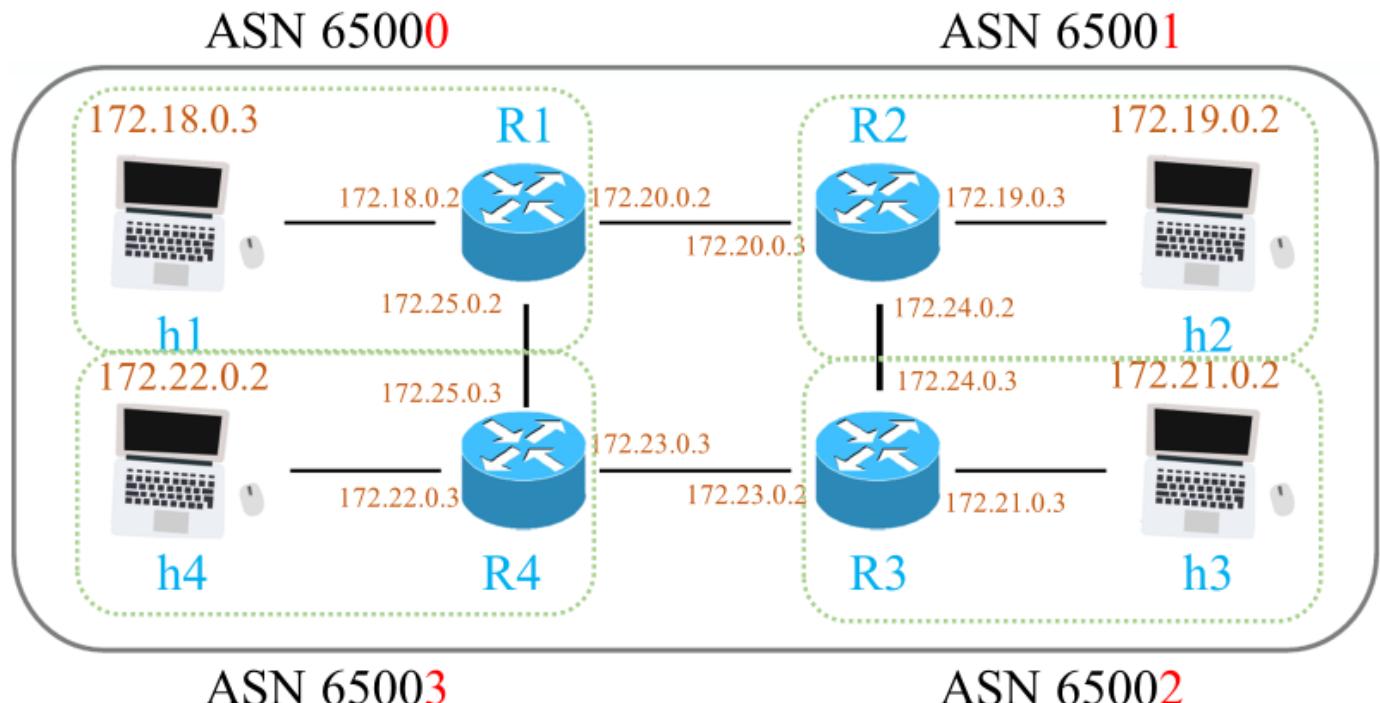


# project6\_109550206

Self Link (<https://hackmd.io/@pinchen/SDNFVproject6>).

## Show topology with IP addresses, interfaces and ASNs



ps -a

CONTAINER ID	IMAGE	COMMAND	CREATED	STATUS	PORTS	NAMES
b3cba41c8eb3	ubuntu:16.04	"/bin/bash"	37 hours ago	Up 37 hours		h3
727c932df350	ubuntu:16.04	"/bin/bash"	39 hours ago	Up 39 hours		R4
ee63a4ab3d27	ubuntu:16.04	"/bin/bash"	39 hours ago	Up 39 hours		h4
66dbbf18e5fd	ubuntu:16.04	"/bin/bash"	39 hours ago	Up 39 hours		R3
206ac5f667f7	ubuntu:16.04	"/bin/bash"	2 days ago	Up 2 days		R2
4f4b6dcbb812	ubuntu:16.04	"/bin/bash"	2 days ago	Up 2 days		h2
0c411caccab2	ubuntu:16.04	"/bin/bash"	2 days ago	Up 2 days		R1
3a5c1a9354bf	ubuntu:16.04	"/bin/bash"	2 days ago	Up 2 days		h1

network ls

```
demo@SDN-NFV:~$ sudo docker network ls
NETWORK ID      NAME      DRIVER      SCOPE
a350a5cc22e6    R1R2br    bridge      local
2d2ebc00b357    R1R4br    bridge      local
ae4391839ab1    R1h1br    bridge      local
a4d646fbcb7d   R2R3br    bridge      local
dbed9f9f6b1d   R2h2br    bridge      local
bf6fc2b278e21   R3R4br    bridge      local
b7e2d0597c8d   R3h3br    bridge      local
3c70edcb8dfb   R4h4br    bridge      local
48e0959512df   bridge     bridge      local
dc15be8926ed   host       host       local
c7a782df45c7   none      null      local
```

# h1

```
demo@SDN-NFV:~$ sudo docker exec -it h1 bash
root@3a5c1a9354bf:/# ifconfig
eth0      Link encap:Ethernet HWaddr 02:42:ac:11:00:02
          inet addr:172.17.0.2 Bcast:172.17.255.255 Mask:255.255.0.0
          UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
          RX packets:246 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:24489 (24.4 KB) TX bytes:0 (0.0 B)

eth1      Link encap:Ethernet HWaddr 02:42:ac:12:00:03
          inet addr:172.18.0.3 Bcast:172.18.255.255 Mask:255.255.0.0
          UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
          RX packets:7373 errors:0 dropped:0 overruns:0 frame:0
          TX packets:7247 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:21863839 (21.8 MB) TX bytes:399345 (399.3 KB)

lo        Link encap:Local Loopback
          inet addr:127.0.0.1 Mask:255.0.0.0
          UP LOOPBACK RUNNING MTU:65536 Metric:1
          RX packets:18 errors:0 dropped:0 overruns:0 frame:0
          TX packets:18 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:1557 (1.5 KB) TX bytes:1557 (1.5 KB)

root@3a5c1a9354bf:/# █
```

# R1

```
demo@SDN-NFV:~$ sudo docker exec -it R1 bash
root@0c411caccab2:/# ifconfig
eth0      Link encap:Ethernet HWaddr 02:42:ac:11:00:03
          inet addr:172.17.0.3 Bcast:172.17.255.255 Mask:255.255.0.0
          UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
          RX packets:220 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:20431 (20.4 KB) TX bytes:0 (0.0 B)

eth1      Link encap:Ethernet HWaddr 02:42:ac:12:00:02
          inet addr:172.18.0.2 Bcast:172.18.255.255 Mask:255.255.0.0
          UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
          RX packets:168 errors:0 dropped:0 overruns:0 frame:0
          TX packets:40 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:24180 (24.1 KB) TX bytes:3640 (3.6 KB)

eth2      Link encap:Ethernet HWaddr 02:42:ac:14:00:02
          inet addr:172.20.0.2 Bcast:172.20.255.255 Mask:255.255.0.0
          UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
          RX packets:25989 errors:0 dropped:0 overruns:0 frame:0
          TX packets:25866 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:38167232 (38.1 MB) TX bytes:1727046 (1.7 MB)

eth3      Link encap:Ethernet HWaddr 02:42:ac:19:00:02
          inet addr:172.25.0.2 Bcast:172.25.255.255 Mask:255.255.0.0
          UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
          RX packets:8084 errors:0 dropped:0 overruns:0 frame:0
          TX packets:7795 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:637218 (637.2 KB) TX bytes:607965 (607.9 KB)

lo        Link encap:Local Loopback
          inet addr:127.0.0.1 Mask:255.0.0.0
          UP LOOPBACK RUNNING MTU:65536 Metric:1
          RX packets:698 errors:0 dropped:0 overruns:0 frame:0
          TX packets:698 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:41398 (41.3 KB) TX bytes:41398 (41.3 KB)

root@0c411caccab2:/# █
```

## h2

```
demo@SDN-NFV:~$ sudo docker exec -it h2 bash
root@4f4b6dcb2812:/# ifconfig
eth0      Link encap:Ethernet HWaddr 02:42:ac:11:00:04
          inet addr:172.17.0.4 Bcast:172.17.255.255 Mask:255.255.0.0
          UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
          RX packets:215 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:19416 (19.4 KB) TX bytes:0 (0.0 B)

eth1      Link encap:Ethernet HWaddr 02:42:ac:13:00:02
          inet addr:172.19.0.2 Bcast:172.19.255.255 Mask:255.255.0.0
          UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
          RX packets:7467 errors:0 dropped:0 overruns:0 frame:0
          TX packets:7320 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:21869405 (21.8 MB) TX bytes:402215 (402.2 KB)

lo        Link encap:Local Loopback
          inet addr:127.0.0.1 Mask:255.0.0.0
          UP LOOPBACK RUNNING MTU:65536 Metric:1
          RX packets:12 errors:0 dropped:0 overruns:0 frame:0
          TX packets:12 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:1018 (1.0 KB) TX bytes:1018 (1.0 KB)

root@4f4b6dcb2812:/# █
```

R2

```
demo@SDN-NFV:~$ sudo docker exec -it R2 bash
root@206ac5f667f7:/# ifconfig
eth0      Link encap:Ethernet HWaddr 02:42:ac:11:00:05
          inet addr:172.17.0.5 Bcast:172.17.255.255 Mask:255.255.0.0
          UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
          RX packets:215 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:19416 (19.4 KB) TX bytes:0 (0.0 B)

eth1      Link encap:Ethernet HWaddr 02:42:ac:13:00:03
          inet addr:172.19.0.3 Bcast:172.19.255.255 Mask:255.255.0.0
          UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
          RX packets:116 errors:0 dropped:0 overruns:0 frame:0
          TX packets:12 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:18043 (18.0 KB) TX bytes:1064 (1.0 KB)

eth2      Link encap:Ethernet HWaddr 02:42:ac:14:00:03
          inet addr:172.20.0.3 Bcast:172.20.255.255 Mask:255.255.0.0
          UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
          RX packets:26098 errors:0 dropped:0 overruns:0 frame:0
          TX packets:25960 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:38175514 (38.1 MB) TX bytes:1731442 (1.7 MB)

eth3      Link encap:Ethernet HWaddr 02:42:ac:18:00:02
          inet addr:172.24.0.2 Bcast:172.24.255.255 Mask:255.255.0.0
          UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
          RX packets:10166 errors:0 dropped:0 overruns:0 frame:0
          TX packets:9999 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:798422 (798.4 KB) TX bytes:778462 (778.4 KB)

lo        Link encap:Local Loopback
          inet addr:127.0.0.1 Mask:255.0.0.0
          UP LOOPBACK RUNNING MTU:65536 Metric:1
          RX packets:489 errors:0 dropped:0 overruns:0 frame:0
          TX packets:489 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:28647 (28.6 KB) TX bytes:28647 (28.6 KB)

root@206ac5f667f7:/# █
```

### h3

```
demo@SDN-NFV:~$ sudo docker exec -it h3 bash
root@b3cba41c8eb3:/# ifconfig
eth0      Link encap:Ethernet HWaddr 02:42:ac:11:00:06
          inet addr:172.17.0.6 Bcast:172.17.255.255 Mask:255.255.0.0
          UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
          RX packets:74 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:11544 (11.5 KB) TX bytes:0 (0.0 B)

eth1      Link encap:Ethernet HWaddr 02:42:ac:15:00:02
          inet addr:172.21.0.2 Bcast:172.21.255.255 Mask:255.255.0.0
          UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
          RX packets:9673 errors:0 dropped:0 overruns:0 frame:0
          TX packets:6137 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:21984064 (21.9 MB) TX bytes:339337 (339.3 KB)

lo        Link encap:Local Loopback
          inet addr:127.0.0.1 Mask:255.0.0.0
          UP LOOPBACK RUNNING MTU:65536 Metric:1
          RX packets:18 errors:0 dropped:0 overruns:0 frame:0
          TX packets:18 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:1510 (1.5 KB) TX bytes:1510 (1.5 KB)

root@b3cba41c8eb3:/#
```

## R3

```
demo@SDN-NFV:~$ sudo docker exec -it R3 bash
root@66dbbf18e5fd:/# ifconfig
eth0      Link encap:Ethernet HWaddr 02:42:ac:11:00:07
          inet addr:172.17.0.7 Bcast:172.17.255.255 Mask:255.255.0.0
          UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
          RX packets:203 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:17425 (17.4 KB) TX bytes:0 (0.0 B)

eth1      Link encap:Ethernet HWaddr 02:42:ac:15:00:03
          inet addr:172.21.0.3 Bcast:172.21.255.255 Mask:255.255.0.0
          UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
          RX packets:173 errors:0 dropped:0 overruns:0 frame:0
          TX packets:19 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:21408 (21.4 KB) TX bytes:1358 (1.3 KB)

eth2      Link encap:Ethernet HWaddr 02:42:ac:17:00:02
          inet addr:172.23.0.2 Bcast:172.23.255.255 Mask:255.255.0.0
          UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
          RX packets:23255 errors:0 dropped:0 overruns:0 frame:0
          TX packets:20857 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:36641286 (36.6 MB) TX bytes:1389851 (1.3 MB)

eth3      Link encap:Ethernet HWaddr 02:42:ac:18:00:03
          inet addr:172.24.0.3 Bcast:172.24.255.255 Mask:255.255.0.0
          UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
          RX packets:10136 errors:0 dropped:0 overruns:0 frame:0
          TX packets:10088 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:797989 (797.9 KB) TX bytes:782783 (782.7 KB)

lo        Link encap:Local Loopback
          inet addr:127.0.0.1 Mask:255.0.0.0
          UP LOOPBACK RUNNING MTU:65536 Metric:1
          RX packets:864 errors:0 dropped:0 overruns:0 frame:0
          TX packets:864 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:50669 (50.6 KB) TX bytes:50669 (50.6 KB)

root@66dbbf18e5fd:/#
```

#### h4

```
demo@SDN-NFV:~$ sudo docker exec -it h4 bash
root@ee63a4ab3d27:/# ifconfig
eth0      Link encap:Ethernet HWaddr 02:42:ac:11:00:08
          inet addr:172.17.0.8 Bcast:172.17.255.255 Mask:255.255.0.0
          UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
          RX packets:204 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:17495 (17.4 KB) TX bytes:0 (0.0 B)

eth1      Link encap:Ethernet HWaddr 02:42:ac:16:00:02
          inet addr:172.22.0.2 Bcast:172.22.255.255 Mask:255.255.0.0
          UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
          RX packets:8029 errors:0 dropped:0 overruns:0 frame:0
          TX packets:6315 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:21900518 (21.9 MB) TX bytes:351330 (351.3 KB)

lo        Link encap:Local Loopback
          inet addr:127.0.0.1 Mask:255.0.0.0
          UP LOOPBACK RUNNING MTU:65536 Metric:1
          RX packets:40 errors:0 dropped:0 overruns:0 frame:0
          TX packets:40 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:3089 (3.0 KB) TX bytes:3089 (3.0 KB)

root@ee63a4ab3d27:/# █
```

R4

```
demo@SDN-NFV:~$ sudo docker exec -it R4 bash
root@727c932df350:/# ifconfig
eth0      Link encap:Ethernet HWaddr 02:42:ac:11:00:09
          inet addr:172.17.0.9 Bcast:172.17.255.255 Mask:255.255.0.0
          UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
          RX packets:203 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:17425 (17.4 KB) TX bytes:0 (0.0 B)

eth1      Link encap:Ethernet HWaddr 02:42:ac:16:00:03
          inet addr:172.22.0.3 Bcast:172.22.255.255 Mask:255.255.0.0
          UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
          RX packets:105 errors:0 dropped:0 overruns:0 frame:0
          TX packets:7 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:16641 (16.6 KB) TX bytes:574 (574.0 B)

eth2      Link encap:Ethernet HWaddr 02:42:ac:17:00:03
          inet addr:172.23.0.3 Bcast:172.23.255.255 Mask:255.255.0.0
          UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
          RX packets:22796 errors:0 dropped:0 overruns:0 frame:0
          TX packets:20990 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:36617930 (36.6 MB) TX bytes:1392742 (1.3 MB)

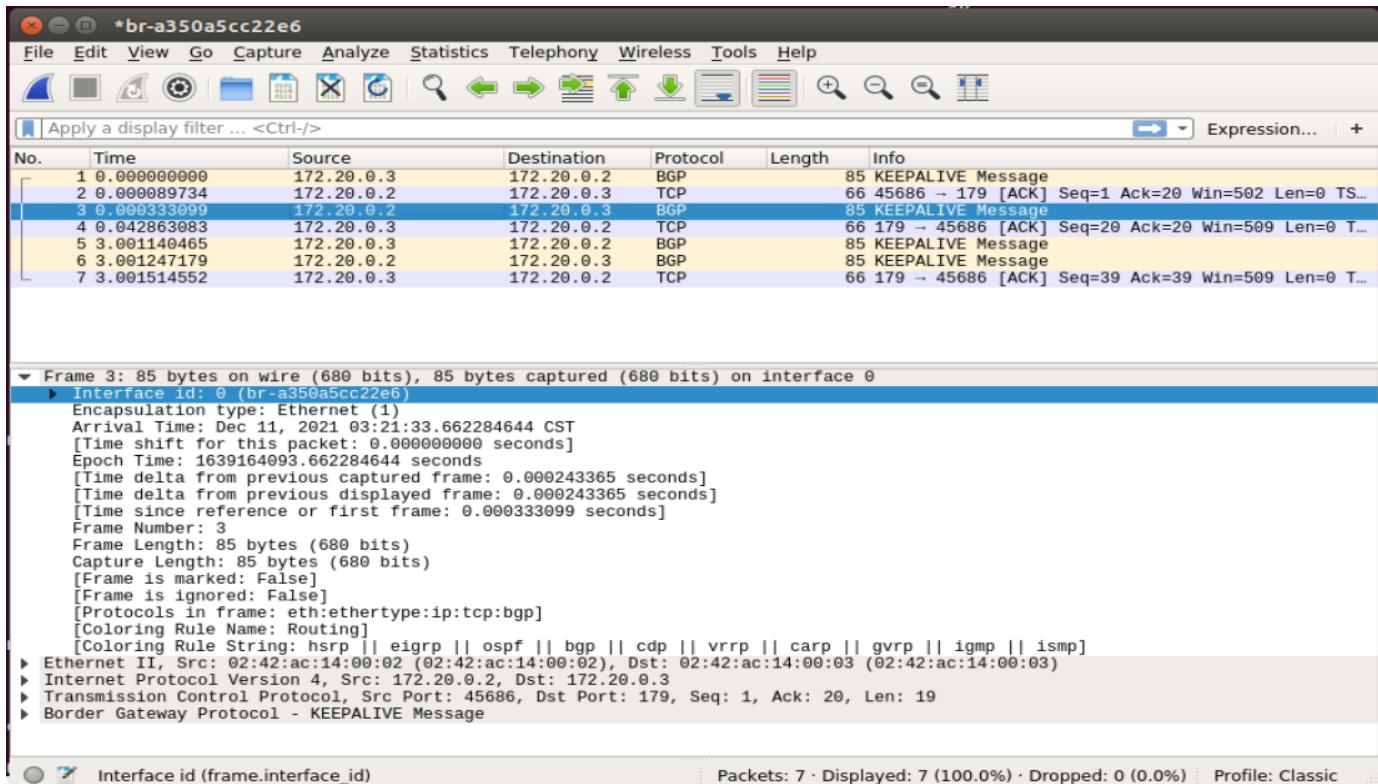
eth3      Link encap:Ethernet HWaddr 02:42:ac:19:00:03
          inet addr:172.25.0.3 Bcast:172.25.255.255 Mask:255.255.0.0
          UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
          RX packets:8029 errors:0 dropped:0 overruns:0 frame:0
          TX packets:8119 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:635925 (635.9 KB) TX bytes:630060 (630.0 KB)

lo        Link encap:Local Loopback
          inet addr:127.0.0.1 Mask:255.0.0.0
          UP LOOPBACK RUNNING MTU:65536 Metric:1
          RX packets:621 errors:0 dropped:0 overruns:0 frame:0
          TX packets:621 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:38394 (38.3 KB) TX bytes:38394 (38.3 KB)

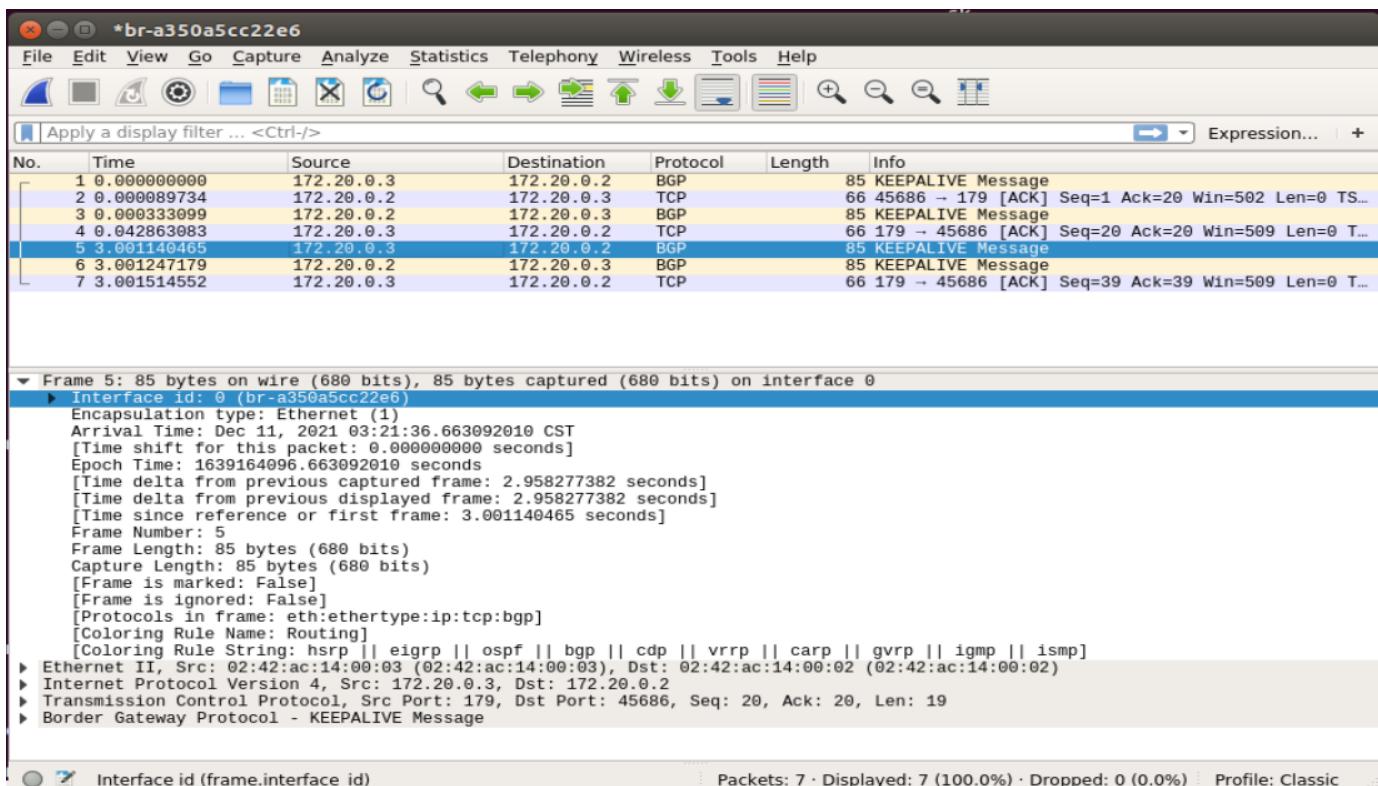
root@727c932df350:/#
```

Capture one pair of BGP packets from wireshark and show screenshots

R1 -> R2 through R1R2br



## R2 -> R1 through R1R2br



## Telnet zebra and bgpd daemons of each route and show route screenshots

### R1 Learned

```

demo@SDN-NFV:~$ sudo docker exec -it R1 bash
root@0c411caccab2:/# route
Kernel IP routing table
Destination     Gateway         Genmask        Flags Metric Ref    Use Iface
default         172.20.0.1   0.0.0.0       UG    0      0        0 eth2
172.17.0.0     *              255.255.0.0   U     0      0        0 eth0
172.18.0.0     *              255.255.0.0   U     0      0        0 eth1
172.19.0.0     R2.R1R2br    255.255.0.0   UG    0      0        0 eth2
172.20.0.0     *              255.255.0.0   U     0      0        0 eth2
172.21.0.0     R2.R1R2br    255.255.0.0   UG    0      0        0 eth2
172.22.0.0     R4.R1R4br    255.255.0.0   UG    0      0        0 eth3
172.25.0.0     *              255.255.0.0   U     0      0        0 eth3
root@0c411caccab2:/# telnet localhost 2601
Trying 127.0.0.1...
Connected to localhost.
Escape character is '^]'.

Hello, this is Quagga (version 0.99.24.1).
Copyright 1996-2005 Kunihiro Ishiguro, et al.

User Access Verification

Password:
R1zebra> show ip route bgp
Codes: K - kernel route, C - connected, S - static, R - RIP,
       O - OSPF, I - IS-IS, B - BGP, P - PIM, A - Babel,
       > - selected route, * - FIB route

B>* 172.19.0.0/16 [20/0] via 172.20.0.3, eth2, 00:12:07
B>* 172.21.0.0/16 [20/0] via 172.20.0.3, eth2, 00:12:02
B>* 172.22.0.0/16 [20/0] via 172.25.0.3, eth3, 00:12:06
R1zebra> exit
Connection closed by foreign host.
root@0c411caccab2:/# telnet localhost 2605
Trying 127.0.0.1...
Connected to localhost.
Escape character is '^]'.

Hello, this is Quagga (version 0.99.24.1).
Copyright 1996-2005 Kunihiro Ishiguro, et al.

User Access Verification

Password:
R1bgp> show ip bgp summary
BGP router identifier 172.20.0.2, local AS number 65000
RIB entries 7, using 784 bytes of memory
Peers 2, using 9136 bytes of memory

Neighbor          V           AS MsgRcvd MsgSent    TblVer  InQ OutQ Up/Down  State/PfxRcd
172.20.0.3        4 65001      5487    5556        0      0      0 00:12:29      3
172.25.0.3        4 65003      5458    5545        0      0      0 00:12:28      2

Total number of neighbors 2
R1bgp>

```

## R2 Learned

```
demo@SDN-NFV:~$ sudo docker exec -it R2 bash
root@206ac5f667f7:/# route
Kernel IP routing table
Destination     Gateway         Genmask        Flags Metric Ref    Use Iface
default         172.20.0.1   0.0.0.0       UG    0      0        0 eth2
172.17.0.0     *             255.255.0.0   U     0      0        0 eth0
172.18.0.0     R1.R1R2br    255.255.0.0   UG    0      0        0 eth2
172.19.0.0     *             255.255.0.0   U     0      0        0 eth1
172.20.0.0     *             255.255.0.0   U     0      0        0 eth2
172.21.0.0     R3.R2R3br    255.255.0.0   UG    0      0        0 eth3
172.22.0.0     R3.R2R3br    255.255.0.0   UG    0      0        0 eth3
172.24.0.0     *             255.255.0.0   U     0      0        0 eth3
root@206ac5f667f7:/# telnet localhost 2601
Trying 127.0.0.1...
Connected to localhost.
Escape character is '^]'.

Hello, this is Quagga (version 0.99.24.1).
Copyright 1996-2005 Kunihiro Ishiguro, et al.

User Access Verification

Password:
R2zebra> show ip route bgp
Codes: K - kernel route, C - connected, S - static, R - RIP,
       O - OSPF, I - IS-IS, B - BGP, P - PIM, A - Babel,
       > - selected route, * - FIB route

B>* 172.18.0.0/16 [20/0] via 172.20.0.2, eth2, 00:14:35
B>* 172.21.0.0/16 [20/0] via 172.24.0.3, eth3, 00:14:33
B>* 172.22.0.0/16 [20/0] via 172.24.0.3, eth3, 00:14:33
R2zebra> exit
Connection closed by foreign host.
root@206ac5f667f7:/# telnet localhost 2605
Trying 127.0.0.1...
Connected to localhost.
Escape character is '^]'.

Hello, this is Quagga (version 0.99.24.1).
Copyright 1996-2005 Kunihiro Ishiguro, et al.

User Access Verification

Password:
R2bgp> show ip bgp summary
BGP router identifier 172.20.0.3, local AS number 65001
RIB entries 7, using 784 bytes of memory
Peers 2, using 9136 bytes of memory

Neighbor          V      AS MsgRcvd MsgSent    TblVer  InQ OutQ Up/Down  State/PfxRcd
172.20.0.2        4 65000  6755    6836        0      0    0 00:14:54        2
172.24.0.3        4 65002  6717    6826        0      0    0 00:14:52        2

Total number of neighbors 2
R2bgp> █
```

## R3 Learned

```

demo@SDN-NFV:~$ sudo docker exec -it R3 bash
root@66dbbf18e5fd:/# route
Kernel IP routing table
Destination     Gateway         Genmask        Flags Metric Ref    Use Iface
default         172.24.0.1   0.0.0.0       UG    0      0        0 eth3
172.17.0.0     *              255.255.0.0   UG    0      0        0 eth0
172.18.0.0     R4.R3R4br    255.255.0.0   UG    0      0        0 eth2
172.19.0.0     R2.R2R3br    255.255.0.0   UG    0      0        0 eth3
172.21.0.0     *              255.255.0.0   U     0      0        0 eth1
172.22.0.0     R4.R3R4br    255.255.0.0   UG    0      0        0 eth2
172.23.0.0     *              255.255.0.0   U     0      0        0 eth2
172.24.0.0     *              255.255.0.0   U     0      0        0 eth3
root@66dbbf18e5fd:/# telnet localhost 2601
Trying 127.0.0.1...
Connected to localhost.
Escape character is '^]'.

Hello, this is Quagga (version 0.99.24.1).
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User Access Verification

Password:
R3zebra> show ip route bgp
Codes: K - kernel route, C - connected, S - static, R - RIP,
       O - OSPF, I - IS-IS, B - BGP, P - PIM, A - Babel,
       > - selected route, * - FIB route

B>* 172.18.0.0/16 [20/0] via 172.23.0.3, eth2, 00:01:34
B>* 172.19.0.0/16 [20/0] via 172.24.0.2, eth3, 00:01:36
B>* 172.22.0.0/16 [20/0] via 172.23.0.3, eth2, 00:01:34
R3zebra> exit
Connection closed by foreign host.
root@66dbbf18e5fd:/# telnet localhost 2605
Trying 127.0.0.1...
Connected to localhost.
Escape character is '^]'.

Hello, this is Quagga (version 0.99.24.1).
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User Access Verification

Password:
R3bgp> show ip bgp summary
BGP router identifier 172.23.0.2, local AS number 65002
RIB entries 7, using 784 bytes of memory
Peers 2, using 9136 bytes of memory

Neighbor      V      AS MsgRcvd MsgSent    TblVer  InQ OutQ Up/Down  State/PfxRcd
172.23.0.3    4 65003   6741    6833      0      0      0 00:01:58      2
172.24.0.2    4 65001   6778    6841      0      0      0 00:02:00      3

Total number of neighbors 2
R3bgp> █

```

## R4 Learned

```
demo@SDN-NFV:~$ sudo docker exec -it R4 bash
root@727c932df350:/# route
Kernel IP routing table
Destination     Gateway         Genmask        Flags Metric Ref    Use Iface
default         172.25.0.1   0.0.0.0       UG    0      0        0 eth3
172.17.0.0     *              255.255.0.0   U     0      0        0 eth0
172.18.0.0     R1.R1R4br    255.255.0.0   UG    0      0        0 eth3
172.19.0.0     R3.R3R4br    255.255.0.0   UG    0      0        0 eth2
172.21.0.0     R3.R3R4br    255.255.0.0   UG    0      0        0 eth2
172.22.0.0     *              255.255.0.0   U     0      0        0 eth1
172.23.0.0     *              255.255.0.0   U     0      0        0 eth2
172.25.0.0     *              255.255.0.0   U     0      0        0 eth3
root@727c932df350:/# telnet localhost 2601
Trying 127.0.0.1...
Connected to localhost.
Escape character is '^]'.

Hello, this is Quagga (version 0.99.24.1).
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```

**User Access Verification**

```
Password:
R4zebra> show ip route bgp
Codes: K - kernel route, C - connected, S - static, R - RIP,
      O - OSPF, I - IS-IS, B - BGP, P - PIM, A - Babel,
      > - selected route, * - FIB route

B>* 172.18.0.0/16 [20/0] via 172.25.0.2, eth3, 00:02:55
B>* 172.19.0.0/16 [20/0] via 172.23.0.2, eth2, 00:02:53
B>* 172.21.0.0/16 [20/0] via 172.23.0.2, eth2, 00:02:53
R4zebra> exit
Connection closed by foreign host.
root@727c932df350:/# telnet localhost 2605
Trying 127.0.0.1...
Connected to localhost.
Escape character is '^]'.

Hello, this is Quagga (version 0.99.24.1).
Copyright 1996-2005 Kunihiro Ishiguro, et al.
```

**User Access Verification**

```
Password:
R4bgp> show ip bgp summary
BGP router identifier 172.23.0.3, local AS number 65003
RIB entries 7, using 784 bytes of memory
Peers 2, using 9136 bytes of memory

Neighbor          V      AS MsgRcvd MsgSent    TblVer  InQ OutQ Up/Down  State/PfxRcd
172.23.0.2        4  65002    5576    5660        0      0    0 00:03:27      2
172.25.0.2        4  65000    5581    5659        0      0    0 00:03:29      3

Total number of neighbors 2
R4bgp>
```

## Write down what you have learned or solved.

於此次lab了解Software Router的設置、架構，熟悉了docker的部分操作、架構，更加了解在NFV下的網路架構。另外發現docker重啟其設定會跑掉要重新設，或許可以嘗試寫shell script自動創建。